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THE BOEING COMPANY

Seattle, Wash 98124

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TITLE: ADVANCED TECHNICAL DATA STUDY

PHASE III - TEST PLAN

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REVISIONS

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LIMITATIONS

NONE

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I. INTRODUCTION

The Advanced Technical Data Research Study was implemented in March 1973. The objectives were to evaluate new techniques and devices for developing and transmitting the technical data required to operate and maintain weapon systems; also, to determine what new concepts should be considered for application to future programs in order to provide accurate data on a timely basis at least cost.

The study was to be conducted in three phases:

PHASE I - Studies made by Government agencies and industry groups on product support technical data problems and on proposed advanced concepts, techniques, and devices for support data preparation; transmittal and retrieval was researched, and published data thereon acquired. A document listing data acquired and containing abstracts of pertinent data was released as "Abstracts of Available Data", Document No. D180-17523-1.

PHASE II - Phase I data was analyzed to the extent necessary to single out the most promising concepts, techniques, and devices for the preparation, transmittal, and retrieval of technical support data. That data was then evaluated against the current "use" environment, modified as necessary, and finally the most promising advanced data system was described in the "Phase II - System Description" document, No. D180-17755-1.

PHASE III - This phase of the study is to develop and test the theory, premises, and feasibility of the concept expressed in the system description produced in Phase II.

I. Introduction, cont'd

This document is the detailed description of the methods, procedures, equipment, and requirements necessary to accomplish the objectives of Phase III.

II. OBJECTIVES

The objectives of this test are to:

1. Determine if the use of microfilmed JPA's are more efficient than conventional T.O.'s by:

    a. Reducing the time spent searching for data.
    b. Reducing the total maintenance task time.
    c. Increasing the accuracy of troubleshooting diagnostics.

2. Determine if lesser-skilled technicians, using microfilmed JPA's, can accomplish the same maintenance task as highly-skilled technicians using conventional T.O.'s.

3. Determine the degree of user acceptance of microfilm JPA's vs. conventional hand-copy manuals.

4. Determine the relative cost impact of microfilm JPA's on a representative weapon system.

The principle upon which proceduralized troubleshooting is based is job simplification by reducing the technical decisions required by today's task performance. These decisions, which the technician would otherwise have to make repeatedly, are produced before the fact but once, and are incorporated into the performance aids. If this is done thoroughly, the technician need only to "look up" the information instead of generating it himself. If he is not required to generate the information, the training requirements are less complex, not as long, and not as expensive. In addition to eliminating a number of sources of error and confusion, his performance should be more reliable.

By microfilming the job performance aids, the "look-up" factor

II. Objectives, continued

has been simplified by reducing the time required to search for the information required and by ease of use of the information once it has been obtained.

A list of those SRAM maintenance procedures selected for conversion to JPA microfilmed format are listed in Appendix A.

III. LOCATION AND SCHEDULE

The test of the JPA microfilm concept will be conducted in the SRAM System Integration Laboratory, located on the first floor of the 2.01 Building of The Boeing Company Plant II complex. This location was selected, rather than Chanute AFB or an operating base as originally planned, for the following reasons:

a. Impact on equipment because of unforeseen problems would be minimal.

b. Engineering staff is available for consultation.

c. Base operating requirements would not impact test results for analysis purposes.

Figure 1 is the overall schedule for Phase III accomplishment.

Figure 2 is the detail schedule for the actual microfilm test as indicated on the Figure 1.

The total test is scheduled for eight (8) days, including a debriefing and critique of the test.

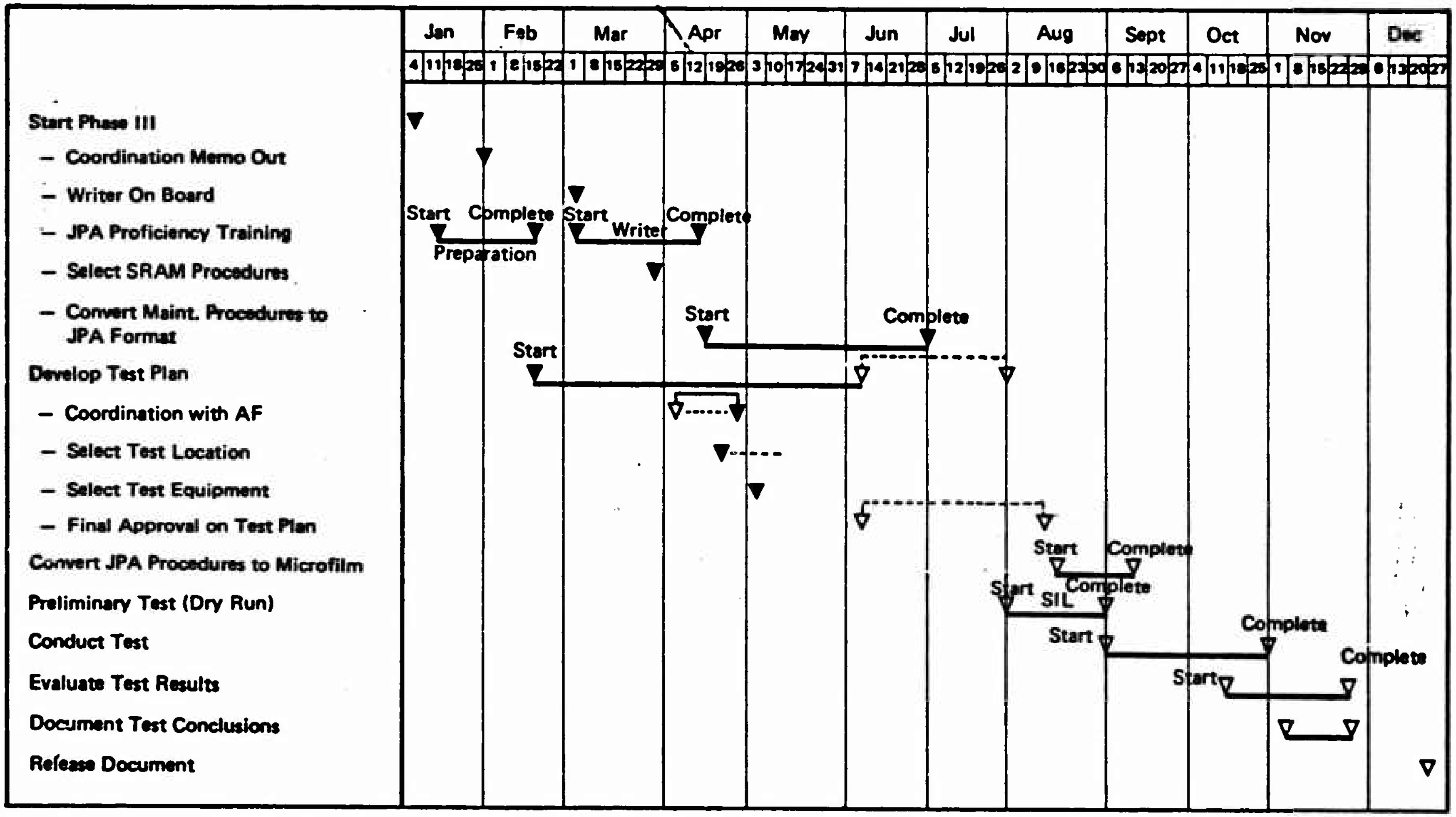

Figure 1: Advanced Technical Data Study Phase III Schedule

Tuesday	Wednesday	Thursday	Friday		Monday	Tuesday	Wednesday	Thursday
	8:00 a.m.	8:00 a.m.	8:00 a.m.	Week End	8:00 a.m.	8:00 a.m.	8:00 a.m.	9:00 a.m.
9:00 Briefing		Fault No. 2 Team No. 2	Fault No.3 Team No. 1		Fault No. 4 Team No. 2	Fault No. 5 Team No. 1	Fault No. 6 Team No. 2	Debriefing
Checkout Team No. 1	Fault No. 1 Team No. 2				Fault No. 4 Team No. 1		Fault No. 6 Team No. 1	
			Fault No. 3 Team No. 2					
	Fault No. 1 Team No. 1	Fault No. 2 Team No. 1				Fault No. 5 Team No. 2		
Checkout Team No. 2								

Figure 2: Detail Test Schedule

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IV. METHOD OF TESTING

The proposed concept of microfilmed JPA's will be tested to verify that the objectives stated in the prior section can be achieved.

The SRAM weapon system was selected as the system on which this concept could be tested most economically and with least amount of statistical variances. The following reasons amplify this position:

a. The system is a mature fielded system with several years accumulated maintenance experience.

b. The Boeing Company prepared the conventional technical orders.

c. Boeing personnel are knowledgeable of the SRAM maintenance requirements.

A review of the total published SRAM maintenance manuals was made to select a manual covering a representative set of maintenance functions from which a representative, sample set of procedures could be selected for use in the test.

The environmental control unit (ECU) was selected as the equipment that would satisfy the requirements for the test.

The ECU is mounted on a four-wheel cart with a welded frame. The main components are: Self-Contained refrigeration cooling unit; Positive displacement blower; Electric motor with variable speed drive to blower; Filters; Control panel; and Container assembly. The container assembly consists of interface items used to connect the AGE ECU with equipment receiving cooling air.

The AGE ECU is used in the SRAM maintenance area to provide

cooling air to Missile Booster Section, and Carrier Aircraft Equipment components (Signal Data Distributor-Processor Group, Signal Data Processing-Distribution Group, Decoder-Multiplexer, Decoder-Multiplexer and Missile Prelaunch Data Computers) during checkout by the Test Adapter Set. Cooling air supplied from the AGE ECU is monitored by sensors and a visual indication of air pressure, temperature and flow are provided by gages located on the control panel. A drop in supply of air flow to less than 1.0 lb/min or rise in temperature to no greater than 98°F will open the pressure or temperature switch contacts. When these contacts open, an alarm signal is sent to the test adapter set which stops the missile test in progress.

This ECU is a mechanical system with electrical controls and drive which provides a wide range of characteristics to examine, observe, or test in the troubleshooting sequences. This provides a testing sample of reasonable scope, which also requires the use of a variety of techniques.

Two (2) two-man teams of Air Force personnel will be used to conduct the test. One team will be composed of highly-trained air-conditioning technicians from Career Field 422. The other team will be composed of recent graduates of the Air Force Air-Conditioning Technical School, also from Career Field No. 422.

After a short indoctrination/orientation session, each team will conduct a system checkout, first using the conventional T.O. checkout procedures and then the microfilmed JPA procedure. Each checkout sequence will be timed by the observer team. Upon completion of the checkout, the SIL technician will cause a malfunction in the equipment by random selection of one of the faults from the Fault Table, Figure 3. Each team will troubleshoot the system to diagnose the malfunction, repair the fault, and verify the repair.

For each malfunction inserted, each team will troubleshoot the

Fault No.	Symptom	Cause	System/ Subsystem	Component Part No.
1	Pressure and flow gages do not show a indication when back pressure applied	Plugged impact tube	Air flow system	Impact tube
2	Compressor oil level in oil sight glass is low	Low oil level	Compressor system	Not applicable
3	Supply temperature gage indicates greater than 75°F	Compressor suction line service valve not fully open	Suction line	Service valve No. A16311 Mueller
4	TAS Alarm activated (Diaphragm pressure switch contacts are not closed when air flow is greater than 1 lb/min.)	Pressure switch is out of adjustment	Electrical/air flow	Pressure switch No. 1637-25 Dwyer
5	Condenser fan motor does not operate	Loose wire connection(s)	Electrical	
6	AGE ECU fails to start (Blower drive motor, compressor motor, fan motors and elapsed time meter fail to run)	Faulty start/stop switch	Electrical	Start/stop switch 29A-22495-101-11

Figure 3: Fault Table

fault using the hard-copy manual first, then the microfilmed JPA next. For each succeeding malfunction, the sequence will be alternated. This will be done to discount the effect of a learning curve on the elapsed task time.

The team time for each major element of each task will be recorded on a form (See Figure 4 for example). Upon completion of diagnosing and repair of all faults, a debriefing will be held to record the comments of the participants in regard to the use of the microfilm in the work environment.

A final detailed test evaluation report will be prepared following completion of the test.

Test Activity	1st Fault Conventional T.O.s	1st Fault Microfilm	2nd Fault Conventional T.O.s	2nd Fault Microfilm	3rd Fault Conventional T.O.s	3rd Fault Microfilm	4th Fault Conventional T.O.s	4th Fault Microfilm
Time Required to Perform Checkout								
Time Required to Research Info								
Time to Isolate Malfunction								
Time to Replace Malfunctioning Component								
Time to Verify Repair								
Time to Perform Total Task								

Figure 4: Microfilm vs Conventional T.O.'s Level – Technician Test Times

V. TEST EQUIPMENT REQUIREMENTS

The following equipment and supplies are required to conduct the test:

1.	ECU	P/N 2A14155A-101-17 or -101-18 (with Lear-Siegler Cooling Unit, P/N AD100-01.)
2.	Multimeter	P/N AN/PSM-6 (FSN 6625-724-8582).
3.	Microfilm Reader Printer	
4.	Stop Watch	
5.	Charging Manifold	P/N A15243 (Mueller Brass Co.)
6.	Face Shield	FSN 4240-542-2048 (Brown & Ballon Tire Mould Corp.)
7.	Gloves	P/N CF 30608 (Mine Safe Appliances Corp.)
8.	Apron	Fed. Spec. ZZ-A-605 (FSN 8415-634-5023)
9.	Tool Service Kit for Refrigeration Unit	P/N 5180-596-1474 (FSCM 19099 S.C. 5180-93-CL E18)
10.	High-Pressure Gage	P/N 1497 (Marsh Instruments)
11.	Low-Pressure Gage	P/N 5801 (Marsh Instruments)
12.	Charging Hose (Require 6 each)	P/N A-16134 (Mueller Brass Co.)
13.	Adapter	P/N A-8073 (Mueller Brass Co.)
14.	Fitting Reducer	P/N A-8127 (Mueller Brass Co.)
15.	Tape	MIL-T-27730A
16.	Hand Tools	
17.	Thermometer	P/N FSN 6685-174-6235
18.	Container	Size optional to permit temperature switch immersion. (Local Purchase)

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19.	Operations & Maintenance Inst. for AGE Electronics ECU	Per T.O. 35M10-5-7-1
20.	Illustrated Parts Breakdown for AGE Electronic ECU	Per T.O. 35M10-5-7-4

APPENDIX A

TROUBLESHOOTING AIDS

VOLUME	TITLE
2-1	AGE ECU Checkout and Troubleshoot
2-2	AGE ECU Start Circuit (Lear-Sieglar) Troubleshoot
2-3	Omitted
2-4	AGE ECU Test Adapter Set Alarm Signal Troubleshoot
2-5	AGE ECU Instruments Troubleshoot
2-6	AGE ECU Blower Unit Troubleshoot
2-7	AGE ECU Cooling Unit (Lear-Sieglar) Troubleshoot
2-8	Omitted
2-9	AGE ECU Cooling Unit Condenser (Lear-Sieglar) Troubleshoot